

WHAT IS CLAIMED IS:

1. A wideband optical fiber amplifier for amplifying S-band optical signals, C-band optical signals and L-band optical signals, said amplifier comprising:
 - 5 a circulator having first, second, and third ports, said circulator outputting a plurality of optical signals into said second port that were input into the first port, and said circulator also outputting an amplified spontaneous emission (ASE) and S-band optical signals to a third port that were input into said second port of said circulator;
 - at least one optical fiber grating for passing the C- and L-band optical signals
 - 10 from among the plurality of optical signals outputted from the second port of the circulator, and for reflecting the S-band optical signals from among the optical signals outputted from the second port of the circulator back to the second port of the circulator, and outputting the ASE inputted into an interior of the optical fiber grating to the second port of the circulator;
 - 15 an outputting unit having at least four terminals for outputting optical signals inputted into first to third terminals to a fourth terminal;
 - a wavelength selective splitter having first, second and third ports for being connected the second terminal of the outputting unit;
 - outputting the L-band optical signals of the optical signals inputted into said
 - 20 first port to the second port of the splitter and for outputting the C-band optical signals of the optical signals inputted into a first port to the third port, the third port of the wavelength selective splitter a first optical fiber amplifying unit connected with the optical fiber grating and the first port of the wavelength selective splitter, for amplifying the C- and L-band optical signals and for outputting the ASE to the optical fiber grating;

a second optical fiber amplifying unit for amplifying the L-band optical signals inputted from the second port of the wavelength selective splitter and for outputting the amplified L-band optical signals to the third terminal of the outputting unit; and

a third optical fiber amplifying unit for amplifying the S-band optical signals
 5 inputted from the third port of the circulator and for outputting the amplified S-band optical signals to the first terminal of the outputting unit.

2. A wideband optical fiber amplifier according to claim 1, wherein the first optical fiber amplifying unit comprises:

10 a first erbium-doped optical fiber for amplifying the C- and L-band optical signals and for outputting C-band ASE;

a first pumping light source for outputting first pumping light for pumping the first erbium-doped optical fiber;

a first wavelength selective coupler having a first, second and third for
 15 outputting the C- and L-band optical signals inputted into a first port and the first pumping light inputted into a third port to a second port f and for outputting the C-band ASE inputted into the second port to the first port the first port of the first wavelength selective coupler being connected to the optical fiber grating, the second port of the first wavelength selective coupler being connected to the first erbium-doped
 20 optical fiber, the third port of the first wavelength selective coupler being connected to the first pumping light source; and

a first isolator connected with the first erbium-doped optical fiber and the first port of the wavelength selective splitter, for outputting the C- and L-band optical signals to the first port of the wavelength selective splitter and for isolating optical signals

inputted from the wavelength selective splitter to the first optical fiber amplifying unit.

3. A wideband optical fiber amplifier according to claim 1, wherein the first erbium-doped optical fiber outputs C-band ASE having a wavelength band of 1560 nm
5 in order to pump the third optical fiber amplifying unit.

4. A wideband optical fiber amplifier according to claim 2, wherein the first erbium-doped optical fiber outputs C-band ASE having a wavelength band of 1560 nm
in order to pump the third optical fiber amplifying unit.

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5. A wideband optical fiber amplifier according to claim 4, wherein the second optical fiber amplifying unit comprises:

a second erbium-doped optical fiber for amplifying the L-band optical signals;

a second pumping light source for outputting second pumping light for
15 pumping the second erbium-doped optical fiber;

a second wavelength selective coupler for outputting the L-band optical signals
inputted into a first port thereof and the second pumping light inputted into a third port
thereof to a second port thereof, the first port of the second wavelength selective coupler
being connected to the second port of the wavelength selective splitter, the second port
20 of the second wavelength selective coupler being connected to the second erbium-doped
optical fiber, the third port of the second wavelength selective coupler being connected
to the second pumping light source; and

a second isolator connected with the second erbium-doped optical fiber and the
third terminal of the outputting unit, for outputting the amplified L-band optical signals

to the third terminal of the outputting unit and for isolating optical signals inputted from the outputting unit to the second optical fiber amplifying unit.

6. A wideband optical fiber amplifier according to claim 1, wherein the
5 outputting unit comprises:

a fourth wavelength selective coupler having first, second and third ports for outputting the L-band optical signals inputted into a first port and the C-band optical signals inputted into a third port to a second port, the first port of the fourth wavelength selective coupler being connected to the second optical fiber amplifying unit, the third
10 port of the fourth wavelength selective coupler being connected to the third port of the wavelength selective splitter; and

a fifth wavelength selective coupler having at least a first, second and third port-for outputting the S-band optical signals inputted into a third port and the C- and L-band optical signals inputted into a first port to a second port, the first port of the fifth
15 wavelength selective coupler being connected to the first port of the fourth wavelength selective coupler, the third port of the fifth wavelength selective coupler being connected to the third optical fiber amplifying unit.

7. A wideband optical fiber amplifier according to claim 3, wherein the third
20 optical fiber amplifying unit comprises:

a thulium-doped optical fiber pumped by the ASE and third pumping light to amplify the S-band optical signals;

a third pumping light source for outputting third pumping light for pumping the thulium-doped optical fiber;

a third wavelength selective coupler having at least first, second and third port for outputting the ASE and S-band optical signals inputted into a first port and the third pumping light inputted into a third port to a second port, the first port of the third wavelength selective coupler being connected to the third port of the circulator, the
 5 second port of the third wavelength selective coupler being connected to the thulium-doped optical fiber, the third port of the third wavelength selective coupler being connected to the third pumping light source; and

a third isolator for outputting the S-band optical signals amplified at the thulium-doped optical fiber to the first terminal of the outputting unit and for isolating
 10 optical signals inputted from the outputting unit to the third optical fiber amplifying unit.

8. A wideband optical fiber amplifier according to claim 7, wherein the third optical fiber amplifying unit further comprises a pumping module for outputting fifth pumping light for pumping the thulium-doped optical fiber.

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9. A wideband optical fiber amplifier according to claim 6, wherein the pumping module comprises:

a fourth pumping light source for outputting fourth pumping light;

a third erbium-doped optical fiber pumped by the fourth pumping light to
 20 amplify fifth pumping light;

a sixth wavelength selective coupler for outputting the S-band optical signals inputted into a first port thereof and the fourth pumping light inputted into a third port thereof to a second port thereof, and for outputting the fifth pumping light inputted from the third erbium-doped optical fiber to the second port thereof to the thulium-doped

optical fiber, the first port of the sixth wavelength selective coupler being connected to the thulium-doped optical fiber, the second port of the sixth wavelength selective coupler being connected to the third erbium-doped optical fiber, the third port of the sixth wavelength selective coupler being connected to the fourth pumping light source;

5 a third isolator for outputting the S-band optical signals inputted into an interior thereof to the first terminal of the outputting unit and for isolating optical signals inputted from the outputting unit to the third optical fiber amplifying unit; and

 an optical fiber grating for outputting the S-band optical signals from among the S-band optical signals and the fifth pumping light to the third isolator and for
10 reflecting the fifth pumping light from among the S-band optical signals and the fifth pumping light back to the third erbium-doped optical fiber, the S-band optical signals and the fifth pumping light being inputted into one end connected to the third erbium-doped optical fiber.

15 10. A wideband optical fiber amplifier according to claim 7, wherein the pumping module comprises:

 a fourth pumping light source for outputting fourth pumping light;

 a third erbium-doped optical fiber pumped by the fourth pumping light to amplify fifth pumping light;

20 a sixth wavelength selective coupler for outputting the S-band optical signals inputted into a first port thereof and the fourth pumping light inputted into a third port thereof to a second port thereof, and for outputting the fifth pumping light inputted from the third erbium-doped optical fiber to the second port thereof to the thulium-doped optical fiber, the first port of the sixth wavelength selective coupler being connected to

the thulium-doped optical fiber, the second port of the sixth wavelength selective coupler being connected to the third erbium-doped optical fiber, the third port of the sixth wavelength selective coupler being connected to the fourth pumping light source;

a third isolator for outputting the S-band optical signals inputted into an interior thereof to the first terminal of the outputting unit and for isolating optical signals inputted from the outputting unit to the third optical fiber amplifying unit; and

an optical fiber grating for outputting the S-band optical signals from among the S-band optical signals and the fifth pumping light to the third isolator and for reflecting the fifth pumping light from among the S-band optical signals and the fifth pumping light back to the third erbium-doped optical fiber, the S-band optical signals and the fifth pumping light being inputted into one end connected to the third erbium-doped optical fiber.

11. A wideband optical fiber amplifier according to claim 10, wherein the third erbium-doped optical fiber is pumped by the fourth pumping light to output the ASE as the fifth pumping light, and amplifies the fifth pumping light reflected at the optical fiber grating to output the second port of the sixth wavelength selective coupler.

12. A wideband optical fiber amplifier according to claim 10, wherein the optical fiber grating includes a Bragg grating on the optical fiber, the Bragg grating having a predetermined period for reflecting the fifth pumping light outputted from the third erbium-doped optical fiber back to the third erbium-doped optical fiber.

13. A wideband optical fiber amplifier according to claim 8, wherein the third pumping light source outputs the third pumping light having a wavelength of 980 nm.

14. A wideband optical fiber amplifier according to claim 10, wherein the
5 third erbium-doped optical fiber outputs the fifth pumping light having a wavelength of 1560 nm.